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A REINFORCEMENT LEARNING MODEL OF PERSUASIVE COMMUNICATION.

BY- WEISS, ROBERT FRANK

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THEORETICAL AND EXPERIMENTAL ANALOGIES ARE DRAWN BETWEEN LEARNING THEORY AND PERSUASIVE COMMUNICATION AS AN EXTENSION OF LIBERALIZED STIMULUS RESPONSE THEORY. IN THE FIRST EXPERIMENT ON INSTRUMENTAL CONDITIONING OF ATTITUDES, THE SUBJECTS READ AN OPINION TO BE LEARNED, FOLLOWED BY A SUPPORTING ARGUMENT ASSUMED TO FUNCTION AS A REINFORCER. THE TIME INTERVAL BETWEEN THE OPINION STATEMENT AND THE REINFORCING ARGUMENT WAS REGARDED AS ANALOGOUS TO DELAY OF REINFORCEMENT. RESULTS OBTAINED ARE CLOSELY ANALOGOUS TO THOSE IN CONDITIONING STUDIES ON DELAY OF REINFORCEMENT. IN AN EXPERIMENT ANALOGOUS TO SELECTIVE LEARNING, WHEN SUBJECTS WERE PERSUADED FOR TWO OPINIONS, WITH ONE REINFORCED WITH A SHORT DELAY OF ARGUMENT AND ONE REINFORCED WITH A LONG DELAY, SUBJECTS TENDED TO CHOOSE THE OPINION PRESENTED WITH THE SHORTER DELAY. IN STUDIES PATTERNED ON CONDITIONING, A DELAY OF REINFORCEMENT COMBINED MULTIPLICATIVELY WITH THE NUMBER OF PERSUASION TRIALS TO DETERMINE ATTITUDE STRENGTH. RESULTS OF OTHER EXPERIMENTS ALSO SUPPORT LIBERALIZED STIMULUS RESPONSE THEORY. THE SYSTEMATIC USE OF LEARNING THEORY AS A MODEL FOR ATTITUDE CHANGE MAKES IT POSSIBLE TO TAKE FULL ADVANTAGE OF PRACTICAL ASPECTS OF LEARNING THEORY. THIS SPEECH WAS PRESENTED AT THE AMERICAN PSYCHOLOGICAL ASSOCIATION CONVENTION, WASHINGTON, D.C., SEPTEMBER 1967. (PR)

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A Reinforcement Learning Model of Persuasive Communication

Robert Frank Weiss

Queens College of the City University of New York

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Alternatives to Consistency Theory in the Study of Attitude Change

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The research I'm going to discuss with you today is an instance of what Neal Miller calls the extension of liberalized S-R theory. Learning-theory has been developed primarily to predict individual behavior in highly controlled experimental situations. The theory has, nevertheless, been extended, with a considerable measure of success, into more complex areas. The explanatory power of learning-theory stems, in part, from two sources. First, Hullian theory includes a number of principles which may be combined in a determinate manner. Principles which may seem relatively trivial when taken singly become powerful explanatory tools when the manner of their interaction can be specified. Secondly, Hullian theory is quantitative, with the usual advantages that attend scientific quantification.

The use of a model in theory construction typically involves the specification of a dictionary of analogies, or rules of correspondence, which relate the variables of the model to the variables of the data area to be explained and predicted. Once this is done, the relations holding among the variables of the model must, theoretically, also hold between the corresponding variables in the data area to be explained. The systematic use of learning theory as a model for attitude change makes it possible to take full advantage of the previously mentioned characteristics of learning theory: combination of principles in a determinate manner and quantitative specification. For example, there are a number of principles regarding delay of reward in instrumental conditioning, 3 of which may be stated informally as

(1) The delay of reward gradient is decreasing and negatively accelerated in shape;

(2) Delay of reward and number of trials combine multiplicatively;

(3) Delay of reward and drive combine additively.

If a social variable is to be theoretically analogous to delay of reward, then we must expect that

(1) This social variable gradient is decreasing and negatively accelerated in shape;

(2) This social variable and number of trials combine multiplicatively;

(3) This social variable and drive combine additively.

So far we've illustrated the development of an analogy between learning and social independent variables. The analogy does not have testable implications until analogies between learning and social dependent variables are also developed. Moreover, it is necessary to clearly specify what kind of learning situation the social conditions are analogous to; approach-avoidance conflict, instrumental reward conditioning, selective learning, etc. differ sharply in certain regards. For example, an important distinction is made in learning research between conditioning and habit reversal. We have not used a habit-reversal model, and we have therefore studied attitude formation in initially neutral subjects, rather than attitude reversal.

Since this is an oral presentation, much of the discussion will be at an informal level, with the more formal theoretical machinery remaining in the background. The mimeographed booklet, Learning Theory and Persuasive Communication, (attached) contains all the figures that will be referred to in this talk. We'll begin with an instrumental reward conditioning model and proceed from there to the selective learning and classical conditioning models.

Instrumental Conditioning

In terms of the empirical law of effect, an event which follows a response and increases the strength of that response on the next trial is called a reinforcer. In the instrumental conditioning of attitudes, subjects read

aloud persuasive communications designed so that the subject says the opinion to be learned, followed by an opinion-supporting argument. This argument consists of information supporting the opinion, and specifically excludes repetitions of the opinion. It seems reasonable to expect that an opinion which is followed by a convincing argument will be strengthened more than an unsupported opinion. Such an argument would then function as a reinforcer of the opinion response and might perhaps exhibit other functional properties of reinforcers. One such property is the inverse relationship between delay of reinforcement and response strength, and a logical development of the paradigm outlined above indicates that delay of argument, the time interval between the opinion response and the reinforcing argument, may be regarded as analogous to delay of reinforcement.

Figure 1 shows the results predicted by the Hullian theory of conditioning, and typically obtained in conditioning studies of delay of reinforcement. Figure 2 shows the closely analogous results obtained in our experiment on delay of argument in persuasive communication. Both delay gradients are negatively accelerated decreasing functions.

Continuing with the analogy between delay of reinforcement and delay of argument we come to Figures 3 and 4. The diverging curves in Figure 3 show how delay of reinforcement and number of conditioning trials combine multiplicatively to determine response speed. Figure 4 shows the same relationship between the corresponding persuasion variables, delay of argument and the number of persuasion trials, one vs. two exposures to the persuasive communication. As in conditioning, delay and trials combine multiplicatively.

In the two delay of reinforcement studies mentioned so far, as well as in the rest of these instrumental conditioning studies, the dependent variable was speed, the reciprocal of latency. In all our experiments on instrumental conditioning of attitudes, the dependent variable was speed of agreement, the

reciprocal of latency of agreement. An attitude measuring apparatus assessed each subject's speed of agreement with the opinion after he had been exposed to the persuasive communication. A statement of the opinion was projected on a screen and the subject signified his agreement (if he agreed) by moving a lever toward the statement. When an opinion was projected on the screen, an electric timer automatically began to measure latency of agreement, until the lever was moved a-quarter-of-an-inch and a photobeam silently stopped the timer.

Returning to the attitude data, we see in Figure 4 that speed of agreement increases from one to two persuasion trials, just as speed increases with conditioning trials. We have some data using conventional attitude measures which does not show this trials effect.

If the argument is analogous to a reinforcer, then a stronger argument should be a stronger reinforcer. Figure 5 indicates that speed is an increasing function of drive and magnitude of reinforcement, and the parallel curves show how these 2 variables combine additively. Figure 6 shows the same relationships among the corresponding persuasion variables: Speed of agreement is an increasing function of strength of argument and Taylor manifest anxiety scale scores, with these two variables combining additively.

Figure 8 shows the results of a study in which we confirmed the persuasion trials effect, but in which we found no significant argument strength effect. We were therefore unable to test the prediction of a multiplicative interaction such as that shown in Figure 7.

Selective Learning

Learning theory treats selective learning as an extension of instrumental reward conditioning. Each subject learns two instrumental reward conditioned responses, which are differentially rewarded. The relative strengths of the two responses may then be assessed by presenting both alternatives simultaneously and allowing the subject to choose between them. The dependent

variable is percent choice. Typically, the number of trials for each response is controlled by forced trials in which the subject is presented with only one of the alternatives, for example, the right arm of the T-maze is closed off and the subject can only go to the left. Selective learning of attitudes is treated as an extension of instrumental attitude conditioning, employing the same persuasive communications. Each subject learns two separate and unrelated instrumental reward conditioned attitudes through exposure to two persuasive communications. Each exposure to a communication constitutes a "forced trial." The relative strength of the two opinions is assessed by presenting both alternatives simultaneously, and then requiring the subject to choose between them. After exposure to the persuasive communications, subjects were tested with the previously described attitude-measuring apparatus, modified so that the two attitude statements were presented simultaneously, one on each of two screens. The subject chose the opinion with which he most agreed by moving the lever toward one of the statements.

When subjects have learned two responses, one reinforced with a short delay and the other with a long delay, the subjects will tend to choose the response which was reinforced with the shorter delay. An analogous result was found in persuasive communication. When subjects were persuaded on two opinions, one reinforced with a short delay of argument and one reinforced with a long delay, the subjects tended to choose the opinion which was persuaded with the shorter delay.

A little-known aspect of Hullian theory is that, under certain circumstances, it predicts that discrimination at <u>low</u> drive will be superior to discrimination at high drive, as shown in Figure 9. As Spence puts it, "The implications of the theory are that there will be an inverse relation between percent choice of short delay and drive level under conditions which keep the reaction potentials in the low range. These conditions may be specified as low initial habit strengths of the two competing responses, the early stages

of selective learning and low ranges of drive level. Thus, it would be expected that a differential in favor of lower drive groups would tend to be present in the early stages of training and at low absolute levels of drive." Analogs of these conditions for keeping excitatory potentials in the low range were met in an experiment, with the results shown in Figure 10. The drive variable was Taylor manifest anxiety. As in selective learning, discrimination was better at low drive than at higher levels of drive.

Classical Conditioning

A persuasive communidation may explicitly state the opinion to be learned, or it may merely imply an opinion, leaving it to the subject to draw the unstated conclusion. In the instrumental conditioning of attitudes, the opinion to be learned is explicitly stated in the communication. In the classical conditioning of attitudes the opinion to be learned is merely implied by the communication, and the subject is left to draw the unstated conclusion for himself. In this theory, the communication-element which implies the opinion is called an opinion-eliciting argument. The technique for the construction of opinion-eliciting arguments is adapted from the work of McGuire. The opinion to be learned is the <u>conclusion</u> of a syllogism. The communication includes the <u>premises</u> of the syllogism (the opinion-eliciting argument), but not the conclusion. Figures 11 and 12 depict corresponding paradigms for a classical conditioning trial and a persuasion trial. Research based on this classical conditioning model requires persuasive communications which incorporate two elements: (1) the Opinion-Eliciting Argument; and (2) the Cue Statement, two neutral words which immediately precede the opinion-eliciting argument and will later constitute part of the test used to measure attitude acquisition. Since the cue statement precedes the opinion-eliciting argument, a subject listening to (or reading) the communication will first hear the cue statement, followed by the opinion-eliciting argument, and then draw the conclusion implied by the argument. This sequence of events may be

regarded as analogous to the sequence: CS, UCS, UR. The cue statement is the CS, and the opinion-eliciting argument is the UCS which elicits the implied opinion--the UR. Through repetition of the sequence the implied opinion becomes conditioned to the cue statement and thus becomes a conditioned opinion as shown in Figure 12.

Following the logic of this paradigm further, the number of repetitions of this sequence is analogous to the number of conditioning trials, and the power of the opinion-eliciting argument to convincingly imply the opinion is analogous to the strength of the UCS. Figure 13 shows that CR probability is an increasing function of number of conditioning trials and UCS strength, and the diverging curves show how these two variables combine multiplicatively. Figure 14 shows the same relationships among the corresponding persuasion variables, opinion-eliciting argument strength, and number of persuasion trials, one vs. three exposures to the persuasive communication. Probability of agreement was an increasing function of argument strength and persuasion trials, with these two variables combining multiplicatively.

In a second experiment on the classical conditioning of attitudes we employed a second analog of UCS strength. We have already noted that the power of the opinion-eliciting argument to convincingly imply an opinion is analogous to UCS strength. Figure 15 shows CR probability as a negatively accelerated increasing function of UCS-strength. Theoretically, then, probability of agreement should be a negatively accelerated increasing function of source credibility. But credibility is normally varied by comparing sources, such as the New York Times and the Volkischer Beobachter, which do not lend themselves to parametric study without dimensional analysis and scaling. We considered doing such a scaling, but first noticed that in credibility research the source has always been individual; a low credibility person or publication constitutes one experimental condition and a high credibility person or publication constitutes the other. If the source were

a group, such as eyewitnesses, experts or reference-group members, it would be possible to vary the degree of consensus among the group source. We used experts as our group source, with 5 levels of consensus: 0% of the experts, 25%, 50%, 75%, and 100% of the experts. As shown in Figures 15 and 16, this technique for varying source credibility yielded a result analogous to UCS effects in conditioning: probability of agreement was a negatively accelerated increasing function of source credibility.

Summary

Employing the general approach which Neal Miller has called extension of liberalized S-R theory, theoretical and experimental analogies were drawn between learning and persuasive communication. The theory includes more analogies than have yet been explored experimentally, and these are listed, for your reference, in the tables on the last page. Instrumental conditioning, selective learning, and classical conditioning were used as models. Theoretically, the functional relationships between the independent and dependent learning variables should also hold between the analogous persuasion variables. In general, the relations among the persuasion variables were found to be isomorphic with the relations among the corresponding learning variables. Thus, for example, delay of argument in persuasion was considered to be analogous to delay of reinforcement in instrumental conditioning and selective learning. As in selective learning, our subjects learned to choose the opinion response which had been "reinforced" with the shorter delay. In attitude "conditioning" a delay of argument gradient of the same shape as a delay of reinforcement gradient was discovered. Again, as in conditioning, delay combined multiplicatively with the number of persuasion "trials" to determine attitude strength. Results of other experiments also tend to support the theory.

Learning Theory and Persuasive Communication

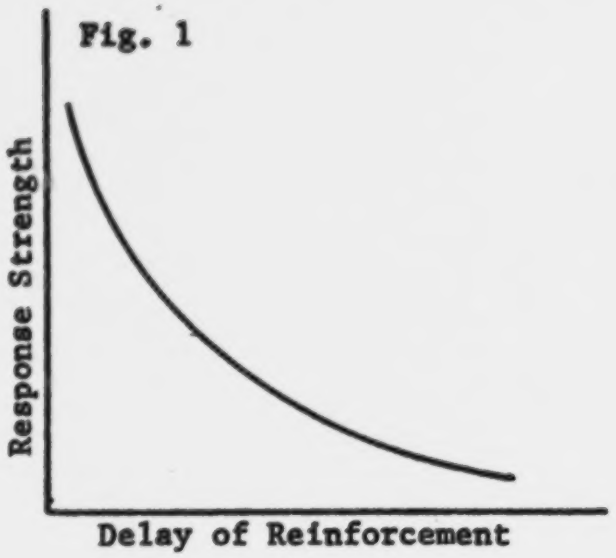
A graphic summary of results

Robert Frank Weiss

Queens College of the City University of New York

INSTRUMENTAL LEARNING

Fig. 1



ATTITUDE LEARNING

Fig. 2

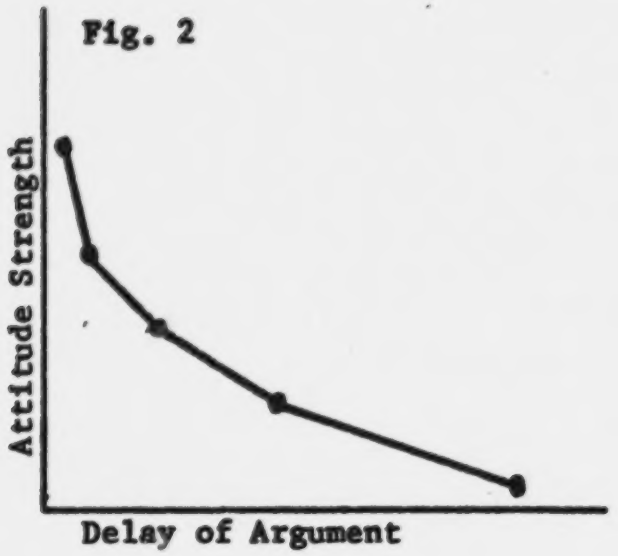


Fig. 3

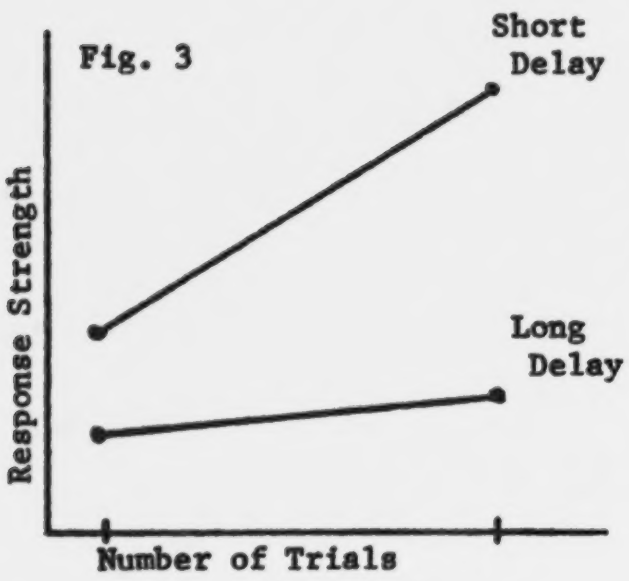


Fig. 4

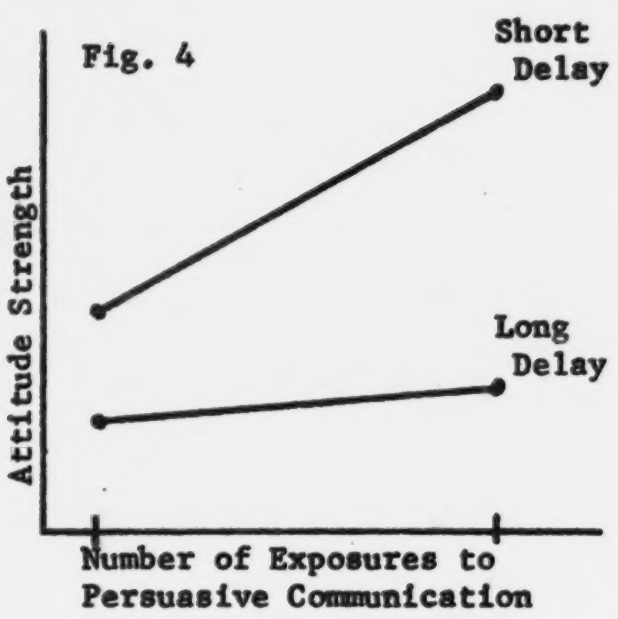


Fig. 5

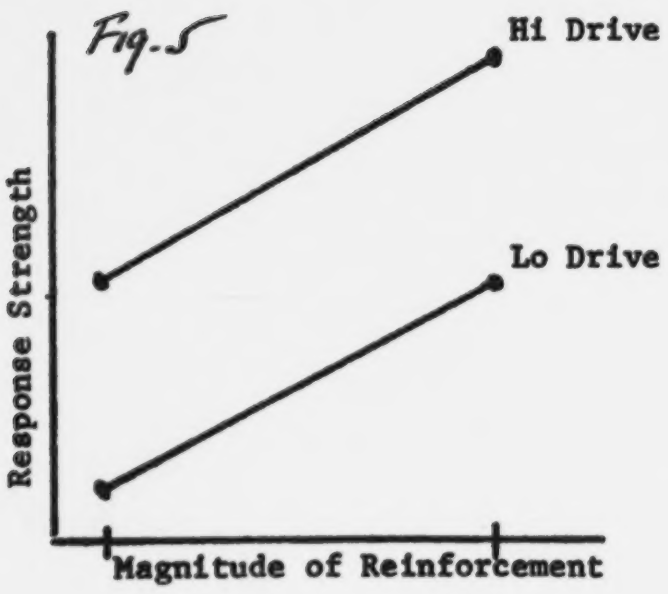
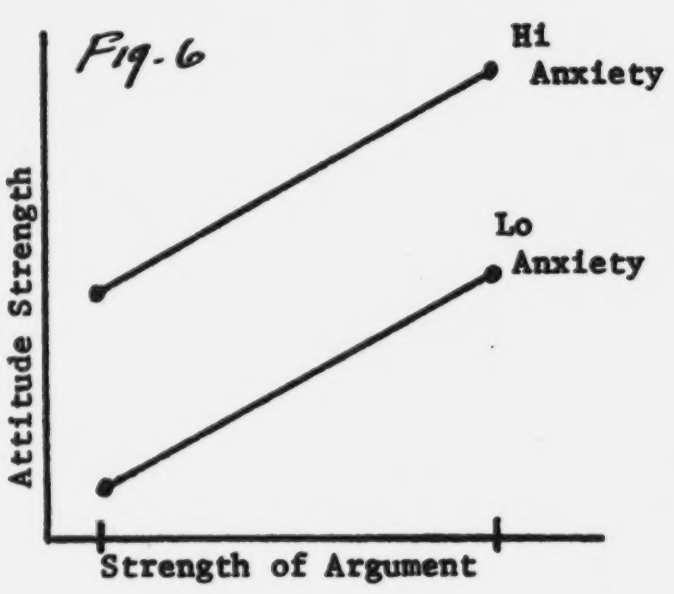
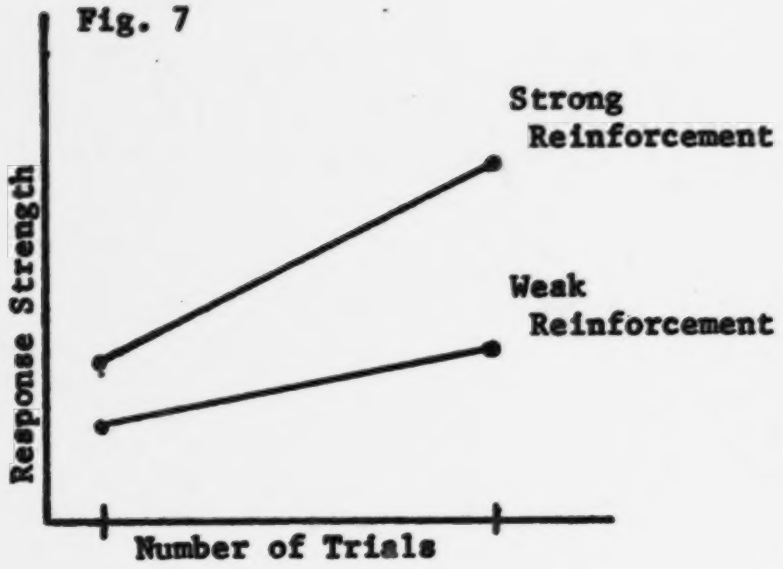


Fig. 6



INSTRUMENTAL LEARNING

Fig. 7



ATTITUDE LEARNING

Fig. 8

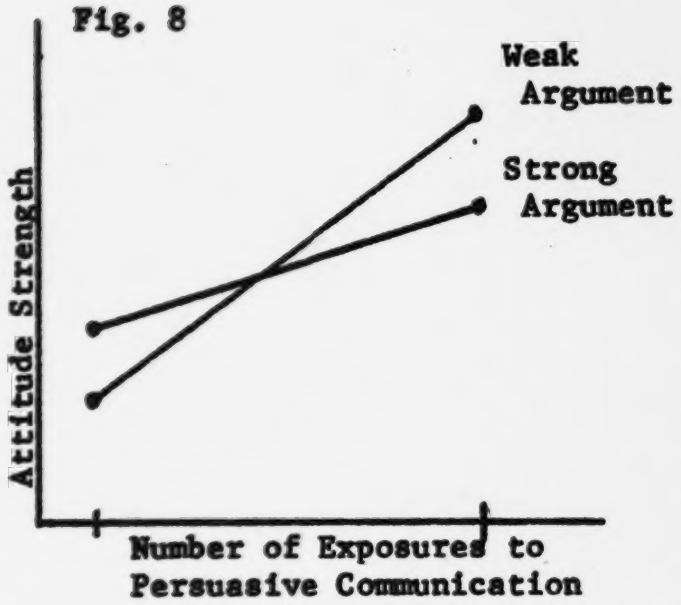


Fig. 9

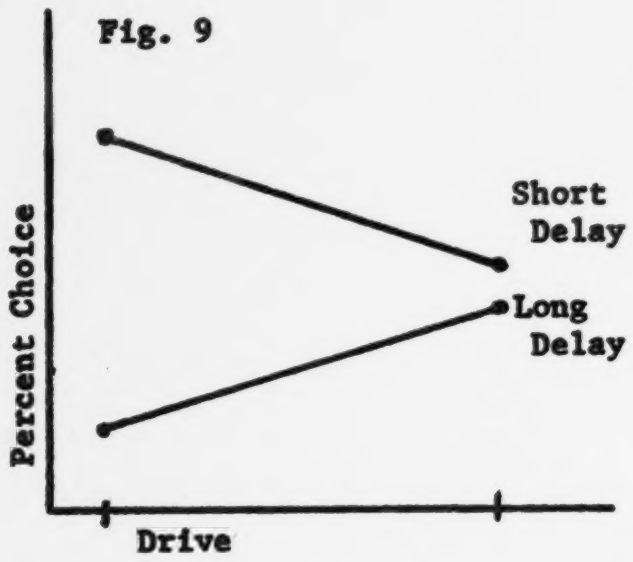
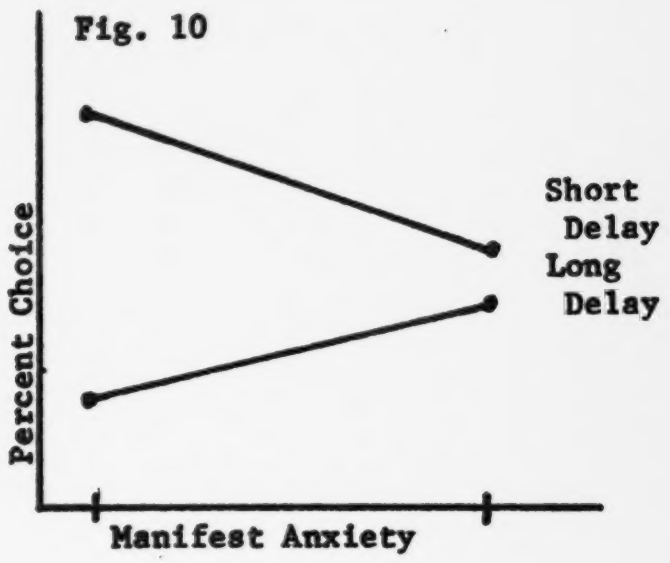
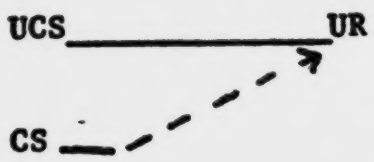


Fig. 10



CLASSICAL CONDITIONING



CLASSICAL ATTITUDE CONDITIONING

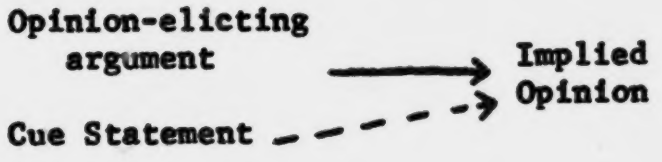


Fig. 13

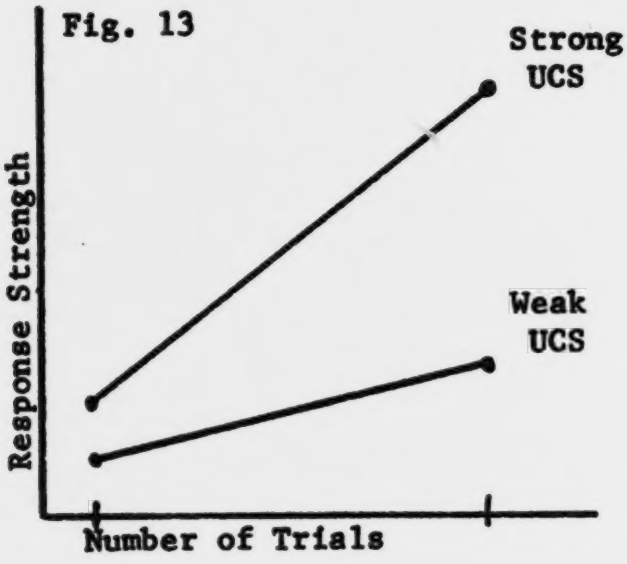


Fig. 14

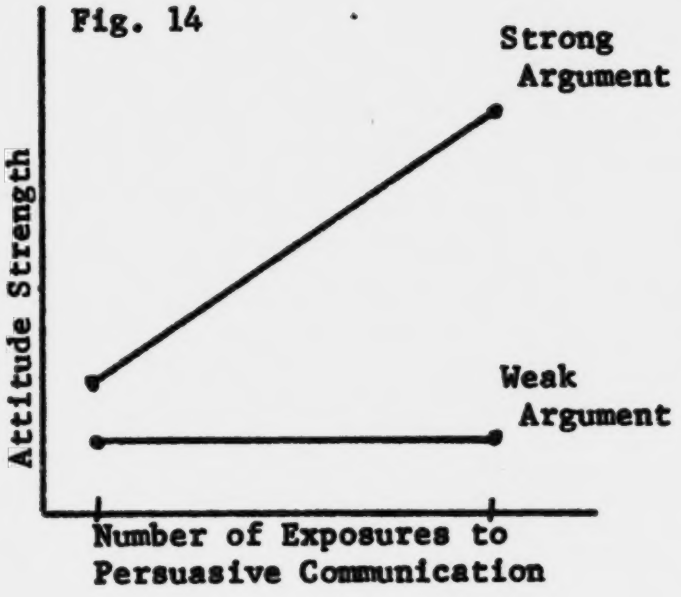


Fig. 15

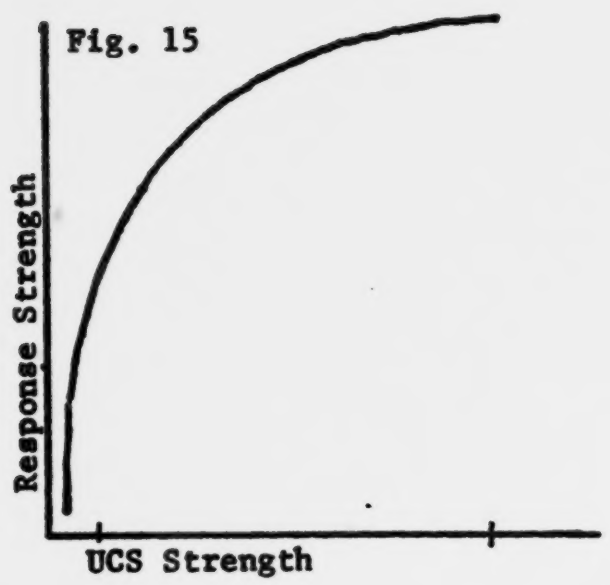


Fig. 16

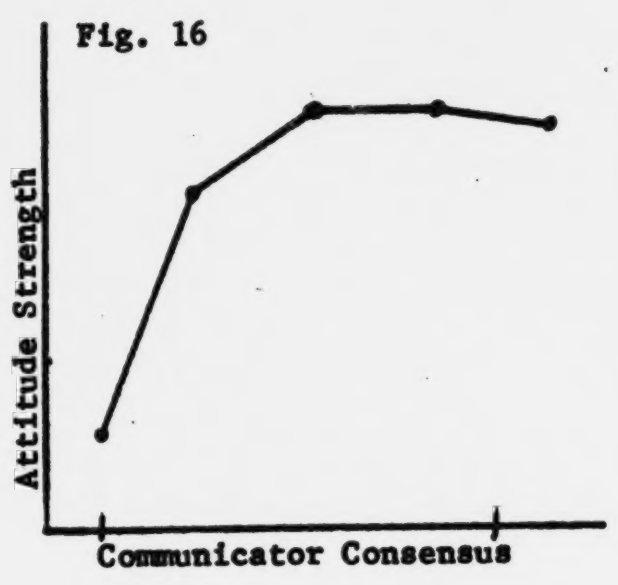


TABLE 1

THEORETICAL ANALOGIES BETWEEN THE INDEPENDENT VARIABLES IN INSTRUMENTAL REWARD LEARNING AND INSTRUMENTAL PERSUASION (RELATION TO INTERVENING VARIABLES ALSO INDICATED)

Persuasion	Learning	Intervening Variable
1. Number of Exposures to Complete Communication	Number of Reinforced *Trials*	*H*
2. Interval Between Exposures to Complete Communication	Inter-trial Interval	*I*
3. Number of Exposures to Argument	Number of Reinforcements	*K*
4. Delay of Argument	Delay of Reinforcement	*K*
5. Length of Opinion Statement	Length of Behavior Chain	*K, I*
6. Strength of Argument	Magnitude of Reinforcement	*K*
7. Source Credibility	Magnitude of Reinforcement	*K*
8. Activeness of Participation in Argument	Vigor of Goal Response	*K*
9. Activeness of Participation in Statement of Opinion	Response Generalization	*H*

TABLE 2

THEORETICAL ANALOGIES BETWEEN THE INDEPENDENT VARIABLES IN CLASSICAL DEFENSE CONDITIONING AND CLASSICAL PERSUASION (RELATION TO INTERVENING VARIABLES ALSO INDICATED)

Persuasion	Learning	Intervening Variable
1. Number of Paired Presentations of Cue Statement and Argument (Complete Communication)	Number of Reinforced Trials	*H*
2. Interval Between Exposures to Complete Communication	Inter-trial Interval	*I*
3. Number of Exposures to Cue Statement Alone	Number of Unreinforced Trials	*I*
4. Number of Exposures to Argument Alone	Number of Exposures to UCS Without CS	*?*
5. Differences in Cue Statement in Persuasion and Testing	CS-Change (Stimulus Generalization)	*H*
6. Activeness of Participation in Cue Statement	CS-Intensity	*H, I*
7. Cue Statement-Argument Interval	CS-UCS Interval	*H, I*
8. Argument Strength	UCS Strength	*D*
9. Source Credibility	UCS Strength	*D*
10. Activeness of Participation in Statement of Argument	UCS Strength (?)	*D*
11. Length of Argument	UCS Duration	*H*